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Wm Boyd's 7th & Arch Essay

On the Anatomy and Functions Of the Skin

Presented to the Medical faculty

Of the

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For the Degree of
Doctor of Medicine
By William R. Smith
Of Virginia

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The Anatomy and Functions of the Skin.

In the selection of this subject, it was first my intention to treat of it experimentally: But, owing to the difficulties to which my situation would have subjected me, & the supervention of several unforeseen interruptions, I have been prevented from executing my original plan. My reading, however, having been directed to this subject, I have determined, with a view to economise time in complying with the law of this Institution, to give some of the various opinions that have been & others that are now entertained, in relation to the structure & functions of the skin.

I am conscious of the too great imperfections of this essay, but sincerely hope, it may serve the end, for which it is alone intended. I might state, in extenuation of its defective condition, the circumstance of this being my first attempt at composition: But here I am disposed to take comfort, permitting myself to repose in the kind & liberal feelings of its judges. I should here also reflect, that

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the ablest and most learned of every science did once study the rudiments of their language. By contrasting, however, your present condition with that in early life, you can not but be conscious of the gradual and almost imperceptible improvement & march of mind, and will on the present occasion, no doubt, make the amplest allowance in behalf of a medical tyro &—

Before entering on the functions of the skin, I have deemed it fit to institute a kind of comparative examination into several of the various divisions of this organ, which have been given by the different anatomists & physiologists. To do which the more effectually & systematically I shall first state, in a concise manner, such divisions as have from time to time been received as most correct, & which come recommended to our notice, by the high & respectable sources, whence they emanate. And in the

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second place, it will be my endeavour, in a very general way, to set forth the division of Dr Lichhorn, being the most recent, in several respects different from the rest, & as I think, very plausible. It is due, however, to the ingenuity & learning of the gentleman's views to state, that were I competent to the task, the almost prescribed limits of an Inaugural Dissertation, would of itself prevent me from doing it justice: And so far from wishing, that their merits may be estimated by the result of this feeble effort of mine, I am in great fear lest I may present them in an unfavourable, if not erroneous light. But, if I have in a single point misrepresented the opinions of Dr Lichhorn, it was not my intention; and is to be ascribed to my imperfect knowledge of the French language, through the medium of which I have gained my information. —

I proceed now to give several of the divisions of the skin; and the most simple of them is, I think, that of Mr.

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Chaussier. According to him, this membrane has but two distinct parts - the dermis & epidermis; the one containing all the organic elements with which it is endowed, and in which take place all the phenomena of vitality, of which it is the seat; the other being the mere inorganic or non-vital portion of it.

In the division of Cruikshank, we find the skin represented as consisting of six different membranes, or more properly speaking, layers. The Cuticle, counting from the exterior, makes the first; the Rete Mucosum is double, and makes the second & third; the first vascular layer, discovered by Dr. then Mr Baynham, of Virginia, and in which the small pox pustules are chiefly seated, makes the fourth; the second vascular layer, separated by continuing the maceration and which renders the pores of the skin very manifest, when it is removed, makes the fifth; & the sixth & last is the Cutis Vera. Thus, continues he, five different layers will be found to lie on the

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surface of the true skin, each of which he conceives to be a cuticle, or an incipient cuticle. The three first are evidently cuticles, either in a formed or an incipient state; and the two last are, most probably, forming into cuticles, which, like the second & third, are to succeed the first. The last or most external is continually falling off in small portions, resembling scales; and this appears to be the only circumstance, which favours Leewenhock's doctrine, that the skin is formed of scales.

Bichat has given us a division, in which the skin is made to consist of the Chorion, or true skin, the reticular body, the papilla & the epidermis. The mucous body of some anatomists, or colouring matter is, according to him, to be met with in one portion of the net-work of extremely fine vessels, which are found, after penetrating the Chorion, to ramify upon its surface, and contain different fluids. The experiments of M. Gaullier would

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go to prove the existence of four distinct membranes or layers in the mucous body alone, which Malpighi has regarded as a mere coat, a sort of varnish covering the papillæ — a varnish for which Bichat has substituted a reticular body, essentially formed of vessels, and divided into two portions independent of each other. M. Gaultier states 1st — there are found immediately above the papillæ a series of small vascular fasceculi, which he designates by the name of sanguineous bunches. 2d — between these bunches & and the epidermis, is seen a black undulating line placed between two white lines, one of which separates it from the first layer, & forms the deep seated whitish layer, composed, according to him, of white vessels. 3d the black line, which is above, or the coloured layer, takes the name of gemmule, on account of its undulations, which makes it appear as if formed of an infinite number of small concave bodies embracing the summits of the papillæ. 4th finally, immediately be-

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low the epidermis is the second colourless layer, or the superficial whitish layer, formed of serous vessels like the first. — The views, however, of Beclard & M. Dutrochet are somewhat different with regard to the first layer of M. Gaultier's division of the mucous body. They do not look upon the sanguineous bunches, constituting this layer, as properly belonging to the mucous body. It is nothing else, say they, than the termination of the vessels ramified in the papillæ, & forms a part of what was formerly called the papillary body: So that, according to them, the layers, which constitute the mucous body, may be reduced in number to three. The analysis, given by M. Dutrochet, of the structure of the skin is consequently as follows. 1st the dermis; 2nd the papillæ; 3rd the epidermoid membrane of the papillæ, which is the deep-seated whitish layer of M. Gaultier; 4th the coloured layer; 5th horny layer, which answers to the superficial whitish layer

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In the excellent & comprehensive anatomical work of Dr Horner, we find the Skin represented as consisting of three laminæ - the Cutis Vera, the Rete mucosum & Cuticula. He thinks, however, the Rete Mucosum is formed of several distinct parts and has adopted the division of M. Gaullier, as modified by M. Dutrochet, the one generally acknowledged & received by the French anatomists and physiologists

No one can fail to acknowledge, that precise and exact notions of the nature & structure of the skin are of the first importance, whether we wish to study its functions, or acquire a correct knowledge and mode of treatment of the numerous maladies, to which this organ is liable. The same remark will hold, with equal weight & propriety, as it regards every other tissue & organ of the body. With the lights of the present advanced state of our science to guide

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him, no physiological physician will be found, who is not influenced, in the symptoms & treatment of diseases, by his acquaintance with the nature & structure of the part or parts, that may be the seat of the morbid actions. If not, he had as well contend, that different tissues, or organs, taking on diseased action, would in all cases produce external symptoms & other signs similar & unvarying, from which its nature may be detected & indications drawn for the best and most successful ~~mode of~~ treatment. The utility of dividing an organ into its constituent parts is confessedly great. This division is not only necessary for correct anatomical description, but facilitates discovery, & leads to just views on function, diseases & their proximate causes. After these preliminary observations, I hope I shall not render myself obnoxious to the opinion, that I look upon the skin as an exception, when I express a belief, that several of the divisions of this organ are forced & unnatural. That they are, however,

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practically or descriptively useful, I am disposed entirely to deny. It is true, my knowledge of anatomy is not of that extensive & minute character, as will warrant me in calling in question the correctness of the divisions of the skin, as given by many anatomists & physiologists - some of whom are deservedly ranked among the greatest men & brightest luminaries of our profession. But let us consider for a moment the various & numerous circumstances, which might have tended to deceive the vision & mock the understanding, as well as to bias the judgement, in the experiments that led to the very minute divisions, I have allusion to. What shall we say of the changes & alterations, that may take place in the texture & consistency of the different parts of the cutaneous organ, when subjected to maceration, the action of alcohol &; and likewise the forced, distended & unnatural condition & change in the relative position of these parts, that may be & are very likely brought

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about by injections. Are not these circumstances, which should certainly be held continually in view, during all our investigations & experiments on the subject; and cause us, at least, to pause sometime, prior to giving an unqualified assent to the correct-ness of their results. In addition to these considera-tions, experimenters may have been biased by precon-ceived notions & theoretical views: and to what ex-tremes may not ambition prompt the talented man - the ingenious & argumentative reasoner. When once he leaps the bounds of demonstrable facts, he enters the field, where fancy & the imagination holds sway; and here having no longer a guide to avoid errour & con-duct to truth, how apt the eye is to see that, which the mind wills, or reasons into existence. Some phy-siologists & anatomists at least could not have been prompted, in their experiments, by the laudable desire to make clear the path of errour & darkness: For in their attempts, they seem but to have given wider

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range to the imagination for vain, idle conjectures & hypothesis. It is curious to observe the various & opposite opinions & conclusions, to which the different experimenters have come, both with regard to the anatomy & physiology of the skin. It is strange to tell, that M. Chaussier could discern but two distinct parts as composing the cutaneous organ, when M. Dutrochet makes three, & M Gaultier four distinct tunics, or membranes proper, as constituting the mucous of Malpighi alone. It is this mucous of Malpighi, which, by its discoverer, was looked upon as a mere varnish covering the papillæ, & by Bichat was regarded as flowing in one set of vessels, constituting a part of his reticular body, and whose very existence, in the white man, has by several been totally denied. M Gaultier has even asserted, that vessels enter into the composition of his deep seated & superficial white tunics. I am inclined to think, however, that either the ambition for discovery, or the imagination of M. Gaultier has carried him too far; or, which is most probable, he has

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been deceived by the appearance of artificial products, resulting from the mode of treating the skin, on which his experiments were performed. I think that Cruickshank has likewise fallen into errour, in making his observations & reasonings on a diseased skin apply to it in a sound state. I offer these remarks with no small degree of diffidence; and should regret exceedingly, did I manifest, in the least, a want of that deference & consideration, which are so justly due to those illustrious men. But, in the opinion, that my views have some semblance of truth or probability, I think I am supported by many experiments & observations, which have been made by Dr Eichhorn, a late writer on the skin. To give, however, to these different portions of the skin, or even to the Mucous of Malpighi, the name of membrane, as some have done, I think is wholy inadmissible: For it seems to me clear, that this mucous of Malpighi is of a fluid nature, & which may

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assume the character of greater or less consistency, as well as different appearances, according to the one or the other mode of treatment, which the skin, destined for experiment & examination, undergoes. But of this, & the two white tunics, more will be said hereafter.

I will now give Dr Lichhorns division of the skin. It appears, says this gentleman, most rational to admit but two principal layers or membranes/couches/ in the general integuments. 1st the epidermis; 2nd the skin properly so called. I understand, says he, by the skin or Cutis, the adipose pannicle, the derma & the mucous of Malpighi, which, when united to the epidermis, constitutes the general integuments. I express, by the name of derma & chorion, the derma proper, as separate & distinct from the adipose pannicle & the mucous of Malpighi. The derma, continues he, may be said to be composed of three portions, each of which has its own peculiar character. The inferior, called the internal vascular, is of a loose

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& soft texture; the middle is more dense, firm & resisting; and the superior, called external vascular, is still of a looser arrangement than the inferior. Although there may not exist any well defined boundaries between these different portions of the derma; yet, if the skin, cut vertically through, be subjected to an inspection by the Microscope, we are enabled to see their different degrees of density - a circumstance, he thinks, of equal importance in physiology & in the treatment of the exanthemata. —

I shall pass over in silence the topographical description of the skin, as also the adipose panicle, and go on to notice cursorily the views of Dr Eichhorn relative to the internal vascular portion of the derma. The inferior portion of the derma is intimately blended or connected with the adipose panicle, & like it, in some measure, contains numerous interstices or cavities. Those of the inferior portion of the derma, however, are more abundant & formed of a more delicate

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cellular tissue than those of the adipose pannicle. These cavities, called by Dr Buchhoan lymphatic, are filled with a fluid entirely different in its nature from that of the adipose pannicle. His experiments would seem clearly to prove it to be an humour very analogous to lymph & containing some albumen. They are most numerous in the back & less abundant where the derma is thinest. They are most voluminous in the neighbourhood of the adipose pannicle. We meet with them in the most dense layer of the derma, but they are small & isolated. They rarely exist in the external portion of the derma, & when they do, they are exceedingly scattering. He says, they can have no immediate relation with the cysts, into which the bulbous extremities of the hairs are inserted, as some anatomists have supposed: For they are most abundant and manifest where the hairs are few & small, and the proportion which they bear to one another he states to be, as 16 or 20 is to 200. He believes the hairs are in

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-planted in the external portion of the derma, & here these cavities, if any do exist, are few & isolated. Although there does not exist an immediate connection between these cavities & the cysts of the hairs, & consequently with the immediate growth of latter; he seems to think, however, they may have a mediate relation with this latter phenomenon or developement of the hairs- since they contain the principles, which resemble more or less those, that enter into the composition of the contents of the cysts. These cavities do not exist in infants; and it is worthy of remark, that the fat under their skin, as well as that of all young animals, is very dissimilar to that of adults in colour, consistence & chemical properties. He then asks, might not the formation of these cavities be dependant on or, in some manner, connected with the change the fat undergoes.

It would, continues he, be a subject curious & interesting to ascertain, if the complete developement of

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these cavities be synchronous with the age of puberty; and that such an inquiry would not fail to shed some light on the conjecture, relative to the possible existence of a mediate connection between these cavities & the growth of the hairs. This being ascertained, we would be encouraged to investigate another point of equal, if not paramount interest & importance. To know, whether these cavities, or rather their contents be not, in some manner, connected with that order of the exanthemata, which affect man but once during life; but more especially with such of them, as are to be met with most frequently in infants. The doctor would consider it a chemico-organic relation. The circumstance, however, of these cavities existing in the derma of every portion of the body, should induce us to believe, they played some grand, important part in our economy; And, says Dr. C., I would venture to consider them, as answering in some measure

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to stomachs in the skin, destined to digest the lymph, but for the abuse, which has been already too frequently made of such comparison, in applying it to absurd hypothesis. He says, if the orifices of the lymphatics be ever discovered by the organ of vision / for I have distinctly seen them with my mind's eye / it will be in these cavities. It is here we ought to find them; because the lymphatics have their roots in the skin generally, & the largest of their radicles certainly border on these cavities.

On removing the internal, loose, vascular portion of the derma, it will be readily perceived, that the tissue of the chorion becomes more & more compact. But according to Lichhorn, its density continues to increase very little beyond the half way point, when again it becomes progressively more loose, as we approach its external surface. He is here opposed to most anatomists who affirm its density to be greatest most externally. In this portion we find spent but few, if any ves-

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sels, carrying red blood - a circumstance important in the consideration of the exanthemata.

The external, loose, vascular portion of the derma comes next to be considered, and from its importance decidedly demands most attention; but time & space will allow me to notice but few of the particulars. The arteries & other vessels, says Dr. E. penetrate the middle portion of the derma without ramifying, and, on reaching its more loose, external cellular arrangement, spread themselves out into a horizontal net-work of extremely fine meshes. He contends, that it is improper to consider the vascular net-work as expanded on the external surface of the derma, but that it takes place under it & in the above described portion, which is no less a portion of the derma, than the middle or any other. He points out the circumstances which led anatomists into this error - All the experiments causing this loose cellular structure to shrivel & retire, whilst the arteries became much more distended &c. Were we to treat, says he,

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the internal vascular portion of the derma in the same way, precisely similar phenomena would result. I shall not be able to notice here his views respecting the serous arteries, the eminences & furrows of the skin, and shall now state, in a concise manner, his conjectures relative to the distribution of the cutaneous nerves. It appears to him exceedingly probable, that the nervous papillæ of the tongue, ends of the fingers &c, may be viewed as masses or collections of nervous matter and vessels, so arranged as to have the nervous substance predominate, and the vascular portion to consist mainly of the nutritious vessels of the nerves. In the other portions of the skin, the vessels prevail, & the nerves there found, are principally those that are requisite to excite the vessels to action. In support of his opinion he adduces the functions of the parts in question. Analogy warrants him in saying, there are no nervous ramifications spent on the cellular tissue of the skin; and it is his opinion, that all the

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nerves of the human skin, which are few in comparison to what we meet with in some other parts as the muscles &c, are spent upon the vessels, without being distributed to the proper tissue of the general integuments. May I not here add? that this arrangement, if correct, is similar to what prevails in the distribution of the nerves to the mucous membranes. —

We come now to the most external portion of the Cutis, which is the mucous of Malpighi. This, however, is no membrane. According to Dr C. there is a very loose & extremely delicate cellular tissue arising from & extending over the derma, into the areolæ of which is secreted this albumino-mucous fluid. It is here, he thinks, we should look for the orifices of the last vascular ramifications. —

The Epidermis next considered. In the opinion of Dr C. the Cuticle is not formed by a desiccation of the mucous, but by an oxydizement of this matter.

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For it is impossible, that desiccation of the mucous should take place in the Fœtus, & yet it is provided with an epidermis. The oxygen, which is requisite for its formation in the Fœtus, is, he thinks, without doubt supplied by the decomposition of the waters of the amnion. The scales, that are continually falling off, are due to the complete oxydation of the most external portion.

On the functions of the skin.

I think we may state the functions of the skin to be as follows - It, together with the mucous membrane, forms a shield or protection for the living body from external agents or the material world, either modifying or rendering their impressions inert. It exhales & secretes certain substances, as carbonic acid gas, vapour sweat, oily matters &; and absorbs certain liquids & gaseous substances, with which it is in contact. It contributes also much to the beauty & embellishment of the

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form of the body. It is the seat of special sensations, as at the ends of the fingers, tongue, penis, clitoris, mamma &, and likewise the general or diffused sensation of touch. But these latter are functions accessory, or for the most part foreign to the Skin proper, and which belong more particularly to the nervous system, to which the cutaneous serves as a means of protection.

Of the Exhalation of Vapour & Sweat, & the Secretion of Oily Matters. With regard to these, I shall say but a few words; for I believe there is at the present day entertained a pretty uniform opinion respecting them. The insensible emanations from the surface of the Skin & were known to many of the older writers, & various were the modes, in which they demonstrated their existence. Tachenius is said to have collected four ounces of water in bed, by previously oiling the sheets. The statical experiments of the great Sanctorius must not be passed unnoticed. He believes that the insensible perspira

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-tion consists of watery vapour possessing certain excrementitious qualities. Supposing a man took, in 24 hours, into his stomach eight pounds of fluid & solid matter, Sanctorius allowed that three pounds passed off by stool & urine, and the other five he said to the account of insensible perspiration, calculating the evaporation from the lungs at one sixth of the whole. Cruikshank, who instituted a series of experiments on this subject, would prove that, under ordinary healthy circumstances, there is lost by insensible exhalations 8 pounds, 9 oz. 36 gr. estimating the evaporation from the lungs at one fifteenth of the whole. But he is of the opinion however, that a great deal enters by the insensible absorption, which, according to him, takes place both in the skin & lungs. He, moreover, believes with Haller, that electricity is perspired from the skin; and as the electric fluid is now shown to be the prime conductor of the variations in the atmosphere,

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he has strong suspicions, that it is the grand conductor of insensible perspiration. The celebrated Edwards, who has paid considerable attention to this subject, does not agree with Sanctorius in supposing insensible perspiration to be entirely checked for three hours after a meal. He also differs with this gentleman & Mr Carick-shank respecting the proportion between cutaneous & pulmonary transpiration, and states it to be much more uniform from the lungs than from the skin, being according to Lavoisier & Seguin a third of the entire amount of transpiration from both surfaces. Did Space allow, it would be pleasing to notice here the importance of insensible & sensible perspiration, as means of depuration, the suppression of which is often followed by the most fatal consequences. They seem to have as their prime object the equilibrium of the temperature of the body. The extent therefore of skin & the importance of its functions, render the due performance of the latter ~~of the latter~~ of the first

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consequence to the general health. The intimate sympathy, which exists between every portion of the tegumentary system, renders it necessary to the health of the individual, that there should exist the most perfect anatomical & physiological integrity: thus, the suppression of the cutaneous exhalation, is almost invariably followed by an increase of exhalation of some of the mucous membranes, & this superabundance of activity, or rather, the humoral congestion which takes place, may be followed by inflammation - such are the most frequent causes of Bronchitis, & Pneumonia, & many other affections. It would have been equally instructive to have given a brief notice of the sebaceous follicles, & the oily secretion from them. It is the retention of this secretion on the skin, which more particularly renders the latter unclean, impedes its function & gives rise or predisposes to cutaneous diseases, & sympathetick disturbances in other organs of the body.

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Previous to an examination of the arguments & experiments for & against the absorption of gases, I have thought it advisable to see how far the lymphatics, or any other vessels may be relied on, to carry these or any other substances from without internally through the tegumentary envelope. It is only very lately, says Wm Homer, that the existence of lymphatic vessels, on the external surface of the skin, has been put beyond a doubt, by the observations & experiments of M. Lauth. Mr Chaussier observes, we are ignorant as to the manner, in which the arteries, veins, nerves & lymphatics arrange themselves, collectively, into a capillary system; and as it respects the latter, we only know, that they form a portion of the elements of each viscus & structure of the body. Wilbrand, because the orifices of these vessels have never been discovered, concludes they do not exist. He allows, that the last ramifications of all the vessels terminate by hollow roots, but without openings; and that around

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them, as around the terminations of the fingers of a glove, there is continually going on a change of solids into liquids & liquids into solids. In this transformation would not the terminations of the vessels themselves take part, alternately becoming fluid & solid? Besides we may ask Mr Wilbrand, who has seen these changes? His own mode of reasoning would recoil upon him, to his entire & complete overthrow. The very reason, he has adduced for rejecting the admission of the orifices of the lymphatics, may be brought with equal weight against the adoption of his own hypothesis; not to mention a host of others proving its absolute absurdity. Some anatomists have supposed the lymphatics communicated directly with the arteries; and Lauth & others believe they open on the inner surface of the latter, whereby injections have been made to pass from one to the other. Most Moderns, I believe, are of the opinion, that the fluids are first deposited in

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the surrounding textures, & are thence removed by the lymphatics & veins. But the following facts will at least go to prove satisfactorily the error, into which Milbrand has fallen; that liquids do not penetrate the walls of the vessels; & that there must be orifices, through which substances pass out & enter the vessels. Sommering found blood in the lymphatics of the lungs - Mascagni & W. Hunter found it likewise in these vessels, the latter of whom saw it even in a coagulated state. Blenland, Cruikshank - Mascagni & Sommering have found also pus in the lymphatics. But it is the opinion of Lichhorn & others, that pus can not, any more than blood, have ade through the vascular tunics; And although it is not likely, that the coagulated blood, found by Hunter, was absorbed in that state, the fact is, nevertheless, very interesting; because, it proves that the blood has been taken up by the lymphatics, together with its fibrine - a substance that can never

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transude through the coats of the vessels. Desgenettes states, he found sand or gravels in the lymphatics. M. Sommering found masses of true stone in the Bronchial glands, & so did Chavet & Simons. But it is not probable that they were either transuded, or lignified, as Wilbrand would have them. In addition to these evidences, the experiments of Hoase, Hewson Cruikshank, M. Reisseisen & might be adduced, but sufficient, I hope, has been said to prove the existence of orifices at the extremities of the lymphatics. It remains now to ascertain the existence or non-existence of these orifices in the Epidermis, about which there has been much dispute & contention. Space will not allow me to enter minutely into this subject: But in the first place, we may state as a thing certain, that the function of the lymphatics is to absorb fluids; and does it not appear impossible, that this absorption should take place, unless their orifices be in contact with the fluid

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or plunged into reservoirs containing it. The fire engine or the Siphon would fail to perform its office, & the water would not ascend, were not one extremity of these instruments situated beneath its surface. Such, I think, would be found to be the result in the case of the Lymphatics. The same reasoning will hold good, whether the power in these vessels to absorb, depend uniformly on a capillary force, or an organic force, inherent in the vessels themselves. Besides the reasoning of Dr Lichhorn on this point is very plausible & deserves to be noticed. Admitting for a moment, that these orifices opened on the surface of the epidermis, where there does not always exist fluids for the vessels to act upon, he asks, if a column of air would not penetrate each ramification of the Lymphatics; since the the power is in force, which caused the fluid to advance in them. What would be the fatal consequences of this, analogy enables us to say - atmospheric air, being admitted into

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the blood vessels, produces instantaneous death. Dr. E. gives a still more powerful proof than that, against the existence of these orifices on the surface of the epidermis. He states, that he has proven in an incontestible manner, that the lymphatics absorb with great avidity the vaccine matter; and that it is on this absorption depends the infection of the individual. Without a solution, however, of the epidermis, the infection of the person will not take place, & we are therefore led to conclude, that these orifices do not exist on its surface. This fact is interesting in another point of view, since some distinguished physicians of the present day believe it to be by sympathy, that an individual becomes affected with the vaccine matter.
After this examination I am inclined to adopt the view, which Dr Eichhorn has taken, respecting the orifices of the lymphatics. He says, we should only look for them in the areolae of the tissues &

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the cavities of the body; And as it regards the skin particularly, we should expect to meet with them in the under portion of the derma. Pus may exist in the middle & external portion of the derma; & that this is the case, appears to be proved, by the action of some medicines when applied to a denuded skin But Dr. C. thinks their effects may be explained on the principle of imbibition. He does not believe either, as some modern physiologists do, that the lymphatics open into cysts of the hairs. If they did mercury could be passed from the one to the other. Besides he has impregnated the roots of the hairs repeatedly with vaccine matter, & yet infection never took place. I shall mention here likewise that air pores, or vessels, in any manner analogous to the tracheas of insects, do not exist in the skin of man. They can not communicate with the lymphatics, for all the reasons would equally apply here which were adduced against their orifices on the

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surface of the epidermis. Nor can they terminate in the arteries & veins, as death would be the inevitable consequence. Besides we do not find the cutaneous venous blood redder than any other venous blood

On the Absorption of fluids by the Skin.

This subject has engaged the attention & pens of many of the ablest & most profound anatomists & physiologists; and yet how different are the opinions & conclusions, to which their reasonings & experiments have led them. The reflection is truly depressing & appalling to a medical tyro, and has no doubt contributed much to damp the fire & fetter the efforts of genius, anxiously searching for truth, or aspiring after some honoured abode in the temple of fame. Let it not, however, be supposed for a moment, that I could be so vain & presumptuous as to select this subject, with a view to a final decision, or even with a hope to shed additional light on this deba-

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-table ground. Let mine be the humbler, yet pleas-
-ing & interesting task, of recounting the labours of
genius & industry, with a view to my own improve-
-ment. I desire to view the steps that have been
trodden, to learn what is known & established, & what
yet remains undecided - for that done, I shall have
made no small progress, towards the attainment of
the final object.

It is difficult to account for the great discrepances of
opinion, with respect to the absorbing power of the
skin. One thing, I think, we may state. that many
have drawn too general a conclusion from observa
tions & experiments otherwise well made. Pouteau, Seguin
& Dr Rousseau, of Phila. contend that the skin does not
absorb at all, or in a very slight degree. Dr. Rous-
-seau in particular, comes to too sweeping a conclusion,
one at least, in which he is not warranted by his
own experiments; for they only prove that the oil
of turpentine is not absorbed. This is equally true

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with respect to all oleaginous substances, as has been proved by M. de Martigny & others. It appears also to have been satisfactorily shown by Drs Dainger-field & Klapp, that neither camphor, asparagus or garlic is taken into the circulation through the skin. And yet the readiness, with which these articles are absorbed by the alimentary canal, would argue that they were not unfriendly to the appetency of the lymphatic vessels. In favour, however, of cutaneous absorption has been adduced the circumstance of men & animals, in humid climates, drinking less, but urinating as much as those inhabiting drier climates; that too of Sailors calming their thirst by bathing, or wearing wet clothes; that of an individual affected with Diabetes, who, although he may drink nothing, will sometimes discharge enormous quantities of water. Besides, the propagation of the contagion of small pox and other diseases has been brought forward to establish its existence,

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Yet no one has proved, that contagion is conveyed from body to body through the Skin: But that it does not, seems to be rendered probable by the operation of vaccination, as here no effect is produced unless the epidermis be raised. Other causes besides cutaneous absorption, may with equal plausibility be assigned for the above phenomena; and, from their exceedingly doubtful import, I am disposed to allow them little or no weight in the consideration of this subject. — The augmentation of the weight of a person in bathing has been contended for by some & absolutely denied by others. Dr Currie's experiment on a diabetic patient is entitled to no force, owing to the morbidly increased secretions of the kidneys &c. But we know that this distinguished gentleman made many experiments on himself, varying the heat of the bath from 87 to 94 degrees, and in no instance did he find his weight augmented. Besides, he

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relates a remarkable case of dysphagia, where death was the consequence of inanition, notwithstanding every attempt to support the system both by the rectum & surface. The patient on different occasions stepped perfectly naked upon Merlin's balance, immediately before immersion & directly after it, his body being previously dried. The weights remained unmoved during the whole of the experiments: But Dr. Carrie could not discern the slightest variation in the weight of the body, tho the beam would have detected a single drachm, tho the immersion had been continued for an hour, & a constant friction kept up, nearly the whole time, with a view of increasing the action of the absorbents. How far the diseased condition of the system could have influenced the result of the last mentioned experiment, I shall not pretend to decide. But on this point there are not wanting some of the most re-

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cent experiments, which lead to quite opposite results. I allude to those of Mr. Collard de Martigny, and which seem to have been as fairly & as satisfactorily conducted as any. By them it is ascertained that water, wine, beer, tea, & milk are absorbed, some with greater, the others with less rapidity: And, as was before stated, it was found, that oleaginous substances are not acted on at all by cutaneous absorption. The experiments, instituted by J. Bradner Stewart, of Albany, & repeated by Lewall, have been cited by Dr Eichhorn as proving, that a portion of the water of the bath is in fact absorbed. It appears from one of these experiments that, if an individual remains two hours & a half in a warm bath, containing extract of Madder, Rhubarb & Carcuma, the existence of these colouring principles may be demonstrated, from 4 to 6 hours after, in the urine, by means of carbonate of potash. The accuracy of this experiment can only be proved by a repetition of it.

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Were we to admit as proofs, however, the various experiments made on animals & fishes, I think it would be a point clearly made out, that there exists a power in the skin to absorb. All the experiments of Dr Alexander Monro on frogs go to prove, that, in their opinion, ardent spirits and essential oils are absorbed. The late Professor Benj. S. Barton, from many observations, was inclined to give credit to cutaneous absorption in frogs. In his account likewise of the Lacerta Lubricaca, we find a single instance of this power. It is a well ascertained fact, says this ingenuous naturalist, that the weight of many of the Amphibia, as the frogs particularly, & likewise the lizards, is very various at different times even in the same day or hour; And that this difference of weight is entirely independent of any aliment, fluid or solid, taken into the stomach, but must be ascribed to the absorption of moisture &c. The celebra

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ted Edwards, who has experimented largely on this subject, believes in the absorption of water by the skin. In opposition to the opinion of Seguin, he is disposed, as well from experiments on animals as from observations on man, to admit cutaneous absorption in water to an extent equivalent to the loss by transpiration in the same medium. This, if correct, will serve to explain the fact, mentioned by Dr Carrie, of the weight of the body not being increased by bathing. Transpiration going on rapidly, if the weight of the body be the same after as before immersion, there must have been absorption to compensate for the loss. Dr Edwards asserts also, that absorption takes place in a humid atmosphere, and the actual loss of weight, in such a medium, is the difference between the loss by transpiration & the gain by absorption, the former process prevailing over the latter. In opposition to this view, however, M. de Martigny, after dis

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covering that absorption in man is most rapid on those parts of the body where exhalation is greatest, remarks, that while exhalation is going on, there is no absorption; that absorption is diminished during exercise, or by an increase of temperature; & that it is increased by a depression of temperature, or by the evacuation of blood. In short, cutaneous absorption is influenced, by every particular, in the inverse ratio of cutaneous exhalation. – From the swelling of the skin in the bath, & the atmosphere when humid, & several other circumstances, Dr Lichhorn is of the opinion, that certain aqueous solutions enter by the process of imbibition. The quantity is, he thinks, small but is difficult to be determined, owing to the dependition which takes place at the same time from the lungs &c. According to him, the watery fluids alone are admitted, or such as are capable of softening & expanding the epidermis. Oils have

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not, says he, the requisite properties & consequently do not enter. This latter view agrees, in part, with the result of M. De Martigny's experiments: But it is the opinion of Martigny, that the function of absorption is carried on by a special & elective action of the capillaries.

Although it appears that the weight of authority is in favour of the opinion, that certain fluids are taken in by the skin; yet, it has been shown, there are not wanted those of distinction, who entirely deny the existence of such a power. Even among its advocates, there exists a great diversity of opinion, respecting the quantity absorbed & the laws by which the process is governed. It should, moreover, be kept in mind, that Amphibious animals are widely different in their anatomical character, way of life and economy, from man; and consequently it is difficult to state, how far analogical reasoning ought

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to serve us in our experiments & inquiries on this subject. —

On the Exhalation & Absorption of Gases. or Cutaneous Respiration.

On this point, as on the other, there has existed a great contrariety of opinion; and the physiological world remains as yet divided & unsettled. But my present province is to know what has been done. Ingenhouz & Lavoisier believed, that air is continually issuing from the skin. Count de Milly notices particularly the air, that is seen to arise in bubbles, on immerging the body in water, & states it to be carbonic acid gas. Professor Woodhouse & some others were of the opinion, we ought to look to the water as the only source, which can yield the air constituting these bubbles. According to these gentlemen, the evolved heat from the body, which was the subject of experiment, expanded the

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gas, contained in the water used, & thus caused the bubbles to escape, as if from the surface of the skin. In support of this view, an experiment is given, which was made by holding the fore-arm, previously invested with varnished silk, being impervious to air, in a vessel of pump water. In a short time innumerable spherical-cles of air were seen, by himself & friends, to to form on the external surface of the silk, and gradually to arise to the top of the water. It is farther corroborated by the experiment of Dr Priestly in water exhausted of its air. Here not a single bubble was found to arise from the surface of the skin, although the immersion was continued for a considerable length of time. The experiments of Cruikshank, on the contrary, would prove, that something passed off with the insensible perspiration, rendering air fixed; and he was of the opinion, that the

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vapour of insensible perspiration was similar in character to that expired from the lungs. Mr Abernethy maintains the belief in the power of the skin to absorb & give out gases. But here I will mention, that Dr Priestly denies that air is contaminated by animal perspiration as it is by respiration; and that the experiments of Seguin lead to results, the very reverse of those of Mr Abernethy. The experiments of Bartholin, Spallanzani, Sorg, Humbolt, Provencal & some others, have been brought forward by Dr Eichhorn to prove, that gases are absorbed, or, at least, that oxygen is. When, for example, the hand is put under a bell glass, filled with oxygen, isolated from the atmospheric air by a mercurial bath, & permitted to remain several hours, we will find, on examination, that oxygen is absorbed & carbonic acid is present, which latter is due to the secretion of the skin. Much analogical reasoning has

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been employed to prove the aeriform function of the skin. It has been shown by many experimenters & especially by Dr Edwards, that some reptiles, whose lungs have been extirpated, continue to live many hours, and absorb more oxygen, by the surface of the body, than they did before, by the lungs; and that they die in a very short time if covered with spirit varnish, so as to prevent the oxygen from entering. Spallanzani experimented on reptiles and Humbolt on fishes - having confined their bodies in different receivers so as to exclude them effectually from the atmosphere, whilst their heads were out & they breathing with ease, both these gentlemen observed in the several apparatuses a diminution of oxygen & the presence of Carbonic acid gas. The experiments of Dr Edwards, however, demand most attention & confidence. They are very ingenious & appear to be entirely satisfactory; but they are

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for too numerous & detailed to be introduced into an essay of this nature. They have placed beyond a doubt the existence of cutaneous respiration in certain orders of beings. The Batrachia, Sauria Ophidia & Chelonia, all receive the vivifying influence of the atmosphere through the medium of their envelopes. The pulmonary respiration is sufficient to maintain the life of some of them in summer, but not the others. Some would seem to suffer more from the loss of their cutaneous, than their pulmonary respiration As, for instance, lizards in summer die in a few hours, if they are reduced to the necessity of breathing by the lungs alone & the vivifying action of the air on the skin be suppressed. This latter peculiarity is observed to an equal extent in many of the batrachia, as the frogs and toads. Among the other proofs of the existence of cutaneous respiration, was the presence of carbon

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-ic acid, which invariably accompanied the experiments of Dr Edwards, conducted always, so as to prevent the lungs from interfering with the correctness of their results. Reasoning from analogy therefore, we should be induced to believe, that a similar power resided in the skin of man; but the propriety of determining the question in this manner is exceedingly doubtful, for reasons before stated. —

Spallanzani & others have pretend to have ascertained, that hydrogen, azote, & carbonic acid were ever taken into the system through the skin, tho in small quantities. It appears to be lickhown, however, that neither azote, nor carbonic acid penetrates the skin from without; and as to hydrogen, so great is its affinity for vegetable & animal matters, it is very likely that a small portion may either pass out or be imbibed. Dr E. appears, nevertheless, to be persuad

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-ed or convinced of one thing, viz. that oxygen pas-
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the skin. But I believe, he is entirely original in his views,
as to the manner, in which this function is per-
-formed.

It will here be recollected, that he stated,
the mucous of Malpighi to be transformed into
Epidermis by the process of oxidation. It is evi-
-dent, says he, that this oxidation should not
exist to the same extent throughout its thick-
-ness. The most external layer of the Epidermis
being in immediate contact with the atmos-
-phere, & which is continually falling off or des-
-quamating, is mostly oxidized. From this, the
oxygen passes by chemical attraction to the se-
-cond portion of the epidermis or epidermis
proper, & then communicates with the mu-
-cous of Malpighi; the consequence of which is
the subsequent solidification & transformation

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of this mucous into epidermis. In metals, exposed to the atmosphere, the same degree of oxidizement is observed. And he moreover contends, that this mucous may undergo a degree of oxidizement so slight, as to have its fluidity & susceptibility to be reabsorbed still preserved. The above phenomenon will, he thinks, account also for the formation of carbonic acid: For, as the oxygen penetrates chemically the whole substance of the skin, it will necessarily combine with the carbon, in contact with which it is here brought, & thus form carbonic acid, which is, says Dr. C. incessantly disengaged from the skin. In support of this view of the subject, Dr Eichhorn has cited some experiments, which had for their end, the whitening of a negro's skin by means of Chlorine. His arm, being subjected to the action of this gas, the skin assumed a white colour entirely uni

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form, which would not have been the case, had it been absorbed by organic pores; but, on the contrary, this membrane would have been speckled only with white. As confirmatory likewise of his views he adduces the experiments of Spallanzani. By these it is proved, that animal bodies, & the various organs entering into their composition, as the muscles, nervous fibre &c, do absorb oxygen even after death. This mode of accounting for the passage of oxygen through the skin will, says Dr Eichhorn, be found more in conformity to the nature of things, without having recourse to the admission, or calling in the aid of that, which has never been proved to exist, viz. particular pores or vessels destined for the absorption of this gas.

As to the plausibility of Dr Eichhorn's reasoning and the extent, to which we are to receive as correct, or probable, his theory of Cuticular for

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mation, and that of carbonic acid, I shall not pretend to decide. The great simplicity & the originality of the view, which he has taken of the subject, were the principal circumstances that recommended it to my consideration. I have thought proper to introduce it at the conclusion of this essay; but to scan its merits would be a task far too responsible for me, and must devolve on the more learned & experienced.

Let me here repeat, that, in the selection of this subject, I was actuated by a desire to know what had been done to elucidate its mysteries, & only promised myself a better & more extensive acquaintance with it, than it was likely I should obtain, did I not write on it. I flatter myself, I have in part accomplished my object; but have deeply to regret, that there now hangs around it so much obscurity & uncertainty. Experiments, that would establish beyond a

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doubt the true structure & functions of the skin, constitutes a desideratum in medicine, and would be replete with the most interesting & important consequences. There is here presented a field for inquiry, that invites to cultivation — whose great treasures & numerous beauties are as yet undescovered, & can not but promise an abundant & fruitful harvest to the fortunate & successful labourer.

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Hudson S. Burr

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